

CLAIMS

What is claimed is:

1           1. An apparatus, comprising:  
2           a semiconductor material;  
3           an optical path through the semiconductor material, the optical path optically coupled  
4           to receive an optical beam, the optical beam including one or more wavelengths; and  
5           a nonlinearly chirped Bragg grating disposed in the semiconductor material, the  
6           optical path including the nonlinearly chirped Bragg grating to substantially reduce chromatic  
7           dispersion in the optical beam.

1           2. The apparatus of claim 1 wherein the nonlinearly chirped Bragg grating includes a  
2           plurality of perturbations of a refractive index in the semiconductor material along the optical  
3           path.

1           3. The apparatus of claim 2 wherein the plurality of perturbations of the refractive  
2           index are provided with regions of silicon and polysilicon disposed in the semiconductor  
3           material with nonlinear periodicity along the optical path.

1           4. The apparatus of claim 3 further comprising an adjustable heater disposed  
2           proximate to the nonlinearly chirped Bragg grating to adjust a temperature along the  
3           nonlinearly chirped Bragg grating, wherein an effective index of refraction along the optical  
4           path is responsive to the temperature along the nonlinearly chirped Bragg grating.

1           5. The apparatus of claim 2 wherein the plurality of perturbations of the refractive  
2 index are provided with periodic regions of silicon and polysilicon disposed in the  
3 semiconductor material along the optical path, the apparatus further including a plurality of  
4 adjustable heaters disposed proximate to the nonlinearly chirped Bragg grating to adjust a  
5 nonlinear temperature gradient in the semiconductor material along the optical path, wherein  
6 an effective index of refraction along the optical path is responsive to the nonlinear  
7 temperature gradient along the nonlinearly chirped Bragg grating.

1           6. The apparatus of claim 2 wherein the nonlinearly chirped Bragg grating includes a  
2 plurality of charge-modulated regions disposed in the semiconductor material along the  
3 optical path, the plurality of charge modulated regions provided with a plurality of insulated  
4 electrodes distributed along the optical path.

1           7. The apparatus of claim 6 wherein adjustable voltages are coupled across the  
2 plurality of insulated electrodes with a nonlinear voltage gradient across the plurality of  
3 insulated electrodes.

1           8. The apparatus of claim 6 wherein an effective index of refraction along the optical  
2 path is responsive to adjustable voltages coupled across the plurality of insulated electrodes.

1           9. The apparatus of claim 6 wherein spacing between the plurality of insulated  
2 electrodes in the semiconductor material along the optical path has nonlinear periodicity.

1           10. The apparatus of claim 1 further comprising a waveguide disposed in the  
2 semiconductor material, the waveguide including the optical path and the nonlinearly chirped  
3 Bragg grating.

1           11. The apparatus of claim 10 wherein the waveguide comprises a rib waveguide  
2 disposed in the semiconductor material.

1           12. The apparatus of claim 1 wherein the optical beam includes said one or more  
2 optical channels centered in wavelength bands located at approximately 1310 or 1550  
3 nanometers.

1           13. A method, comprising:  
2 directing an optical beam through a semiconductor material and to a nonlinearly  
3 chirped Bragg grating disposed in the semiconductor material;  
4 reflecting portions of the optical beam matching a Bragg condition of the nonlinearly  
5 chirped Bragg grating to provide a first chromatic dispersion to the optical beam; and  
6 adjusting the Bragg condition of the nonlinearly chirped Bragg grating to adjust the  
7 first chromatic dispersion provided to the optical beam.

1           14. The method of claim 13 further comprising substantially negating effects of a  
2 second chromatic dispersion introduced to the optical beam, wherein said first chromatic  
3 dispersion is of opposite sign and substantially equal to said second chromatic dispersion,  
4 said negating effects of said second chromatic dispersion introduced to the optical beam

5 comprising said reflecting portions of the optical beam matching the Bragg condition of the  
6 sampled nonlinearly chirped Bragg grating.

1 15. The method of claim 13 wherein said adjusting the Bragg condition of the  
2 nonlinearly chirped Bragg grating comprises adjusting an effective refractive index in the  
3 semiconductor material along an optical path of the sampled nonlinearly chirped Bragg  
4 grating.

1 16. The method of claim 15 wherein said adjusting the effective refractive index in  
2 the semiconductor material along the optical path of the nonlinearly chirped Bragg grating  
3 comprises adjusting a temperature of the semiconductor material including the sampled  
4 nonlinearly chirped Bragg grating.

1 17. The method of claim 16 wherein said adjusting the temperature of the  
2 semiconductor material including the nonlinearly chirped Bragg grating includes adjusting  
3 the temperature of the semiconductor material to have a nonlinear temperature gradient along  
4 the optical path of the sampled nonlinearly chirped Bragg grating.

1 18. The method of claim 16 wherein said adjusting the temperature of the  
2 semiconductor material including the nonlinearly chirped Bragg grating includes adjusting  
3 the temperature of the semiconductor material to have a uniform temperature along the  
4 optical path of the sampled nonlinearly chirped Bragg grating, the nonlinearly chirped Bragg  
5 grating including regions of silicon and polysilicon disposed in the semiconductor material

6 with nonlinear periodicity along the optical path of the sampled nonlinearly chirped Bragg  
7 grating.

1 19. The method of claim 15 wherein said adjusting the effective refractive index in  
2 the semiconductor material along the optical path of the nonlinearly chirped Bragg grating  
3 comprises adjusting a concentration of charge in each of a plurality of charge modulated  
4 regions disposed in the semiconductor material along the optical path, the plurality of charge  
5 modulated regions provided with a plurality of insulated electrodes distributed along the  
6 optical path.

1 20. The method of claim 19 wherein said adjusting the concentration of charge in  
2 each of the plurality of charge modulated regions in the semiconductor material along the  
3 optical path includes coupling adjustable voltages across the plurality of insulated electrodes  
4 with a nonlinear voltage gradient across the plurality of insulated electrodes.

1 21. The method of claim 19 wherein said adjusting the concentration of charge in  
2 each of the plurality of charge modulated regions in the semiconductor material along the  
3 optical path includes coupling adjustable voltages across the plurality of insulated electrodes  
4 with a uniform voltage across the plurality of insulated electrodes, the plurality of insulated  
5 electrodes distributed in the semiconductor material along the optical path with nonlinear  
6 periodicity.

1 22. The method of claim 14 wherein the optical beam includes a plurality  
2 wavelengths, wherein said negating the effects of the second chromatic dispersion introduced

3 to the optical beam comprises negating the effects of the second chromatic dispersion  
4 introduced to each of the plurality of wavelengths included in the optical beam.

1 23. The method of claim 13 wherein the optical beam includes a plurality  
2 wavelengths, the method further comprising selecting at least one of the plurality of  
3 wavelengths to negate the effects of the second chromatic dispersion introduced to the  
4 selected wavelength included in the optical beam, wherein the adjusting of the Bragg  
5 condition of the nonlinearly chirped Bragg grating is in response to the selected wavelength  
6 included in the optical beam.

1 24. The method of claim 14 wherein the effects of the second chromatic dispersion in  
2 the optical beam are introduced prior to said directing the optical beam through the  
3 semiconductor material and to the nonlinearly chirped Bragg grating disposed in the  
4 semiconductor material.

1 25. The method of claim 14 wherein the effects of the second chromatic dispersion in  
2 the optical beam are introduced after said directing the optical beam through the  
3 semiconductor material and to the nonlinearly chirped Bragg grating disposed in the  
4 semiconductor material.

1 26. A system, comprising:  
2 a first optical device to transmit an optical beam;  
3 a second optical device optically coupled to receive the optical beam from the first  
4 optical device; and

5 a tunable dispersion compensation device optically coupled between the first and  
6 second optical devices, the optical beam directed from the first optical device through an  
7 optical fiber and to the tunable chromatic dispersion compensation device to the second  
8 optical device, the tunable dispersion compensation device including:

- 9 a semiconductor material;
- 10 an optical path through the semiconductor material, the optical optically  
11 coupled to receive the optical beam; and
- 12 a nonlinearly chirped Bragg grating disposed in the semiconductor material  
13 along the optical path, the nonlinearly chirped Bragg grating having a tunable Bragg  
14 condition, the nonlinearly chirped Bragg grating optically coupled to reflect the  
15 optical beam with reduced chromatic dispersion in the reflected optical beam.

1 27. The system of claim 26 wherein the nonlinearly chirped Bragg grating includes  
2 regions of silicon and polysilicon disposed in the semiconductor material with nonlinear  
3 periodicity along the optical path.

1 28. The system of claim 26 wherein the tunable dispersion compensation device  
2 includes a heater disposed proximate to the semiconductor material to adjust a temperature of  
3 the semiconductor material of the nonlinearly chirped Bragg grating to adjust an effective  
4 refractive index along the sampled nonlinearly chirped Bragg grating.

1 29. The system of claim 28 wherein the tunable dispersion compensation device  
2 includes a plurality of charge modulated regions disposed in the semiconductor material

- 3 along the optical path, the plurality of charge modulated regions provided with a plurality of  
4 insulated electrodes distributed along the optical path.

- 1 30. The system of claim 29 wherein adjustable voltages are coupled across the  
2 plurality of insulated electrodes with a nonlinear voltage gradient across the plurality of  
3 insulated electrodes.

- 1 31. The system of claim 29 wherein adjustable voltages are coupled across the  
2 plurality of insulated electrodes and wherein the plurality of insulated electrodes are  
3 distributed in the semiconductor material along the optical path with nonlinear periodicity.